

Article



# Introduction of Al into the HPM-1 Framework by In Situ Generated Seeds as an Alternative Methodology

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Received: 10 July 2018; Accepted: 29 July 2018; Published: 13 September 2018

**Keywords:** STW zeolite; aluminosilicate; seeds; 2-ethyl-1,3,4-trimethylimidazolium; hydrofluoric media; ethanol dehydration

# **Electronic Supplementary Information (ESI)**

### 1. Experimental Section



Figure S1. Scheme of the synthesis.



**Figure S2.** SEM/EDX mapping of the sample SiAl25. The microscope employed was a Hitachi TM3000 with an EDX Spectrum (EDAX).

#### 3. Textural Analysis Results

The nitrogen sorption isotherms of the calcined samples SiAl15, SiAl25 and SiAl35 were obtained and results are shown below. The three isotherms were type IV, characteristic of microporous solids, and showed a slight type H4 hysteresis related to a small quantity of slit-shaped mesopores, probably caused by particle agglomeration [1,2]. The surface area was calculated using the BET equation (1) and applying the Keii-Rouquerol criteria for determining the range [1,3].

$$\frac{(p/p_0)}{V(1-\frac{p}{p_0})} = \frac{1}{V_m} + \frac{(C-1)(p/p_0)}{V_m C}$$
(1)

where  $p/p_0$  is the relative pressure, V is the adsorbed gas quantity, c is the BET constant and V<sub>m</sub> is the monolayer adsorbed gas quantity. The Dubinin-Radushkevi (DR) method was also employed to analyse the isotherm based on equations (2)–(4) [4].

$$\beta = \frac{E}{E_0} \tag{2}$$

$$\log_{10}(V) = \log_{10}(V_m) - D(\log_{10}\left(\frac{p_0}{p}\right))^2$$
(3)

$$D = 2.303 \frac{k(RT)^2}{\beta^2}$$
(4)

Where  $\beta$  is the affinity coefficient, *E* and *E*<sub>0</sub> are the adsorption potentials belonging to different adsorbent vapours interacting with the same adsorbent, and *D* is a constant derived from the DR equation. The alpha plot methodology was chosen to compare to the results of the DR method. This method is used to calculate V<sub>0</sub> and external + mesoporous surface using a reference. The coefficient  $\alpha$  is similar to  $p/p_0$  and is defined in equation (5). The standard used in the present application is the silica standard found in the book by Gregg and Sing [5,6].

$$\alpha = \frac{V}{V_0} \tag{5}$$

The Gurvich rule is applied to evaluate the total pore volume [1]. The adsorbed gas quantity at  $p/p_0$  equal to 0.984 is used, because it is the value at which all the pores will be very near saturation. The resulting value of the total pore volume is then, subtracted from the volume of micropores obtained by DR and alpha plot methods to obtain the mesopores' volume.

3.1. Sample SiAl15



Figure S3. Nitrogen sorption isotherm.

Fable S1.	Textural	analysis	of the	calcined	sample	SiAl15
<b>Fable S1</b> .	Textural	analysis	s of the	calcined	sample	SiAl15

BET Method				Gurv	ich Rule			
SBET	h noint	Total p	ore volume	Mesopore	es volume	Mesopores volume		
$(m^2 \cdot g^{-1})$	b point	(cm <sup>3</sup> ·g <sup>-1</sup> )		(DR) (cm <sup>3</sup> ·g <sup>-1</sup> )		(Alpha plot, cm <sup>3</sup> ·g <sup>-1</sup> )		
332	0.013		0.19	.19 0.09		0.06		
Alpha Plot Method					Dubinin- Radushkevi Method			
V <sub>0</sub> (cm <sup>3</sup> ·g <sup>-1</sup> )	Extern mesopo surface (r	External+ Mie mesoporous Surface (m <sup>2</sup> ·g <sup>-1</sup> )		Microporous surface (BET, m²·g-¹)		В	V <sub>0</sub> (cm <sup>3</sup> ·g <sup>-1</sup> )	
0.10	66	- 1	26	6	0.0134	0.33	0.13	

3.2. Sample SiAl25



Figure S4. Nitrogen sorption isotherm.

BET Method		Gurvich Rule					
SBET	h noint	Total pore volume	Mesopore	Mesopores volume		Mesopores volume	
$(m^2 \cdot g^{-1})$	b point	(cm <sup>3</sup> ·g <sup>-1</sup> )	(DR) (cm <sup>3</sup> ·g <sup>-1</sup> )		(Alpha plot, cm <sup>3</sup> ·g <sup>-1</sup> )		
631	0.014	0.26	0.03		0.06		
	Alpha	Plot Method		Dubinin-Radushkevi Method			
V <sub>0</sub> (cm <sup>3</sup> ·g <sup>-1</sup> )	External mesoporc surface (m <sup>2</sup>	H+ Micropord bus (BET, <sup>2</sup> ·g <sup>-1</sup> )	ous surface m²·g <sup>-1</sup> )	D	В	V <sub>0</sub> (cm <sup>3</sup> ·g <sup>-1</sup> )	
0.20	109	5/	22	4.667·10 <sup>-3</sup>	0.33	0.23	

Table S2. Textural analysis of the calcined sample SiAl25.

#### 3.3. Sample SiAl35



Figure S5. Nitrogen sorption isotherm.

BET Method			Gurvich Rule					
SBET	h noint	Total p	ore volume	Mesopores volume (DR)		Mesopores volume		
$(m^2 \cdot g^{-1})$	b point	(cm <sup>3</sup> ·g <sup>-1</sup> )		(cm <sup>3</sup> ·g <sup>-1</sup> )		(Alpha plot, cm <sup>3</sup> ·g <sup>-1</sup> )		
623	0.009		0.26	0.02		0.06		
Alpha Plot Method					Dubinin- Radushkevi Method			
V <sub>0</sub> (cm <sup>3</sup> ·g <sup>-1</sup> )	Exterr mesopo surface (	External + esoporous face (m <sup>2</sup> ·g <sup>-1</sup> ) (BET, 1		ous surface m²·g-1)	D	В	V <sub>0</sub> (cm <sup>3</sup> ·g <sup>-1</sup> )	
0.20	105	5	5	18	9.046·10 <sup>-3</sup>	0.33	0.24	

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